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Consumer Acceptance of Thermostabilized, Oil-Processed, and Natural Shell Eggs[1] (A Pilot Study)

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SUMMARY

A pilot-scale study was conducted in Birmingham, Ala., to determine consumer acceptance of thermostabilized, oil-processed, and natural shell eggs. Sampling consumer opinion through the use of a questionnaire brought a 52-percent return, covering 1,881 dozen eggs sold in four stores.

Results of the study indicate that consumers are aware of egg-quality values and recognize common defects in shell eggs. Approximately 75 percent of the eggs in the study were used for egg dishes, mostly fried and scrambled eggs; the other 25 percent, for such dishes as cakes and custards. Natural eggs had the best acceptance in the making of both kinds of products.

Consumers gave practically the same rating to thermostabilized and oil-processed eggs, with the oil-processed eggs and those thermostabilized at 136° F. being rated somewhat higher than eggs stabilized at 130°.

Buyers in high-income areas were more critical in their appraisal of the eggs they bought than those in the middle- and low-income areas.

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[1] This report covers a part of the research program of the Poultry Branch directed toward the solution of technical problems under commercial plant operating conditions. The work was carried on under authority of the Research and Marketing Act of 1946.

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A change in the whipping properties of the whites was one of the defects in the thermostabilized eggs noted by consumers, who, however, reported no difficulty in making angel food cake from these eggs. The consumers reported complete satisfaction in using eggs thermostabilized at 136° for making angel food cake, and least satisfaction for this use with untreated, or natural eggs.

Of the miscellaneous remarks about the eggs, 73 percent were favorable, 20 percent were unfavorable on the score of use and functional properties, and 7 percent were unfavorable because of the price or size of the eggs.

Despite some unfavorable comments, no complaints were received at any of the stores and no eggs were returned.

INTRODUCTION

The poultry industry realizes that consumers must receive a uniformly high-quality product, at the lowest possible price, if maximum use is to be made of eggs. Eggs lose in quality as they move through marketing channels from farms to retail outlets. Maintenance of quality through the marketing channels, therefore, is important to both handlers and producers.

Dipping eggs in oil and holding eggs in refrigerated rooms have long been common methods of retarding deterioration in quality. Under the more recent process of thermostabilization (*1*),[2] developed at the University of Missouri, eggs are heated in oil or water in such a way as to stabilize them and reduce deterioration. Shell eggs are heated to about 130° F. and kept at that temperature for about 16 minutes. Storage studies (*2*, *3*, *4*) show that thermostabilized eggs hold their quality during storage better than either oil-treated or natural eggs.

Previous research (*2*, *3*) also showed that thermostabilization altered the whipping quality of egg whites, and made necessary longer whipping to obtain a foam volume comparable to that from natural eggs. It showed further that the albumen adhered to the shell more than in either oil-treated or natural eggs (*2*).

PURPOSE OF STUDY

The thermostabilization method appears to offer advantages in the marketing of eggs. To evaluate these advantages, a study was made to determine, on a pilot scale, whether or not consumers have marked likes or dislikes for thermostabilized eggs when used in ordinary ways. An effort was made to compare consumer acceptance of thermostabilized eggs with that of natural eggs and shell-protected eggs, by marketing the three types through the same outlets and obtaining information from buyers of such eggs.

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[2] Italic numbers in parentheses refer to Literature Cited, p. 13.

EXPERIMENTAL PROCEDURE

A survey on thermostabilized, oil-processed, and natural eggs was conducted in Birmingham, Ala., in October and November 1949. A wholesale pack of eggs from east-central Missouri was processed in Kansas City and then shipped to Birmingham for sale. The eggs were candled to remove any that were cracked, inedible, or of low quality, but they were not graded into cases of a single grade. Two hundred cases, comprising 6,000 dozen eggs, were used in the study. Of the 200 cases, 35 contained natural, or untreated, eggs, 60 contained eggs shell-protected with oil, 50 contained eggs thermostabilized for 16 minutes at 130° F., and 55 contained eggs thermostabilized for 16 minutes at 136°. The shell-protecting operation involved exposure of the eggs to a flowing film of 50- to 60-viscosity oil for 8 minutes at 100° F., followed by thorough draining to remove excess oil from the eggs, which were then placed in new cases. The thermostabilized eggs were removed from the stabilizing machine, air-cooled before an electric fan until the internal temperature of the eggs was below 100°, and then packed in new cases for shipment.

Small test lots of the treated eggs were sent to Iowa State College for a study of cooking uses, and the college plans to publish the results obtained. The rest of the eggs were shipped by truck from Kansas City to Birmingham in three lots, during consecutive weeks—on October 31, 25 cases; on November 7, 100 cases; and on November 14, 75 cases.

At the warehouse in Birmingham the eggs were graded and cartoned by private company graders. Of the 6,000 dozen, approximately 4,800 dozen were within the limits of Grade A, large eggs, based on standards established by the cooperating company. Only cartons of large, company Grade A eggs were used in the consumer study.

Each carton was stamped with a code number to identify the treatment the eggs had received, the number of the case in which the eggs had been shipped from Kansas City, the store where the eggs were sold, and the date the eggs were cartoned. The cartoned eggs in wooden and fiber cases were transferred by truck to four retail stores in widely divergent sections of the city—No. 1, in a low-income area; No. 2, in a middle-income area; and No. 3 and No. 4, in high-income areas.

The eggs were transferred to the stores on Mondays and Thursdays in lots based on the proportionate weekly egg sales of each store. The average air temperature in stores where eggs were placed on open floor counters was 73° to 75° F. The temperature in open refrigerated cases was approximately 50°. The experimental eggs were displayed in the stores next to the regular cartoned eggs. Except for the inconspicuous code number, the cartons were identical, and there was no indication that the eggs differed from other eggs.

In Store No. 1 the eggs were sold from both an open refrigerated case and an open floor counter, most of them from the floor counter. Some eggs in Store No. 2 were sold from a closed refrigerated case and some from an open floor counter. In Store No. 3 the eggs were sold almost wholly from an open refrigerated case. In Store No. 4 they were sold from both an open refrigerated case and an open floor counter.

After a customer had voluntarily selected a test carton or cartons, an interviewer assigned to the store explained the purpose of the study and asked the consumer to participate in it. If the customer agreed, a numbered questionnaire card, showing the code number on the carton purchased, was given to her.

The interviewers handed out 3,112 questionnaire cards in the course of the survey. Consumers' names and telephone numbers or addresses were recorded with the numbers of the cards handed out so that anyone who did not return her card could be contacted by telephone. At no time was the customer given any information on the character of the eggs in the carton.

The questionnaire postal card (copy, below) asked each consumer to indicate (1) how many of the eggs were used in each of nine ways, (2) whether or not the eggs were liked for each use, (3) for which uses the eggs were disliked and why, (4) additional remarks, and (5) whether or not a card had been mailed previously in this survey.

The eggs cartoned and delivered to the stores represented 80 percent of those shipped from Kansas City. A breakdown of the 1,622 completed cards (table 1) shows that 806 cards handed out with thermostabilized eggs were returned, 502 given with oil-processed eggs were returned, and 314 given with natural eggs were returned.

QUESTIONNAIRE CARD

Budget Bureau No. 40–R2032
Approval Expires 1/31/50

Code No. ----------------------------

How many eggs were used as:

Fried ------------ Scrambled ---------------- Poached ------
Soft boiled ------- Hard boiled --------------- Custard ------
Plain cake -------- Angel Food Cake ---------- Other uses -----

2. Did you like them for each of these uses?--------- Yes ☐ No ☐

3. If "No", for which uses did you dislike them? -------------------

Why? --

4. Remarks: --

Have you mailed a card before? (please check)------- Yes ☐ No ☐

The 52-percent return of the questionnaire cards handed out at the four stores covers 39.2 percent of the eggs distributed. The percentage return of cards was about the same for each type of the experimental eggs—37 percent for the thermostabilized eggs; 41.6 percent for the oil-processed eggs; and 41.3 percent for the natural eggs.

TABLE 1.—*Dozens of eggs and number of questionnaire cards completed*

Egg type	Eggs shipped from Kansas City	Eggs cartoned for retail stores	Percentage cartoned	Questionnaire cards completed[1]			Eggs represented by replies	Cartoned eggs on which cards were completed
				Mail	Telephone	Total		
	Dozen	*Dozen*	*Percent*	*Number*	*Number*	*Number*	*Dozen*	*Percent*
Thermostabilized	3, 150	2, 518	79. 9	446	360	806	933	37. 0
Oil-processed	1, 800	1, 434	79. 6	296	206	502	597	41. 6
Natural	1, 050	848	80. 7	198	116	314	351	41. 3
Total or average	6, 000	4, 800	80. 0	940	682	1, 622	1, 881	39. 2

[1] Questionnaire cards were presented to 3,112 purchasers of eggs. Replies represent approximately 52 percent of all questionnaire cards distributed.

Replies to the question of how many eggs were used for various purposes cover 1,029 dozen eggs (table 2). Approximately three-fourths of all the eggs were for egg dishes, mostly fried and scrambled eggs; the rest were for cooking use. The variation between the percentages for each type of eggs used for each purpose was slight. The consumers used most of the eggs in such ways that defects in quality would have been readily apparent when the egg was broken. The percentage of use was highest where defects in appearance would be most noticeable and lowest where physical, or functional, defects would be most noticeable.

TABLE 2.—*Uses of eggs of specified treatment*

Egg use	Type of eggs			Average all types[1]
	Thermo-stabilized	Oil-processed	Natural	
	Percent	*Percent*	*Percent*	*Percent*
Table use:				
Fried	32	36	35	34
Scrambled	26	27	25	26
Hard-boiled	8	6	7	7
Soft-boiled	5	6	6	6
Poached	5	4	4	4
Total	76	79	77	77
Cooking use:				
Plain cake	6	7	6	6
Custard	5	4	6	5
Other	13	10	11	12
Total	24	21	23	23
Grand total	100	100	100	100
Dozens represented[2]	503	312	214	[3] 1,029

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[1] Based on weighted averages.

[2] These figures represent 54 percent of the eggs listed in all replies on thermo-stabilized eggs, 52 percent of all listed on oil-processed eggs, and 61 percent of all listed on natural eggs.

[3] Answers were completed for 1,029 out of 1,881 dozen eggs on which cards were returned.

The results from replies to questionnaire cards received by mail were much like those from cards filled out from telephone interviews (table 3).

TABLE 3.—*Likes and dislikes for eggs used for frying*

Reply on questionnaire	Reply received by—				Total replies	
	Mail		Telephone			
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*
Like	677	94	464	96	1, 141	95
Dislike	47	6	21	4	68	5
Total	724	100	485	100	1, 209	100

In determining the average numbers of eggs per dozen used in specific ways (table 4), one consumer may be represented in one or more of 8 uses, depending on which egg dishes were made. The returned cards were sorted according to those who reported the use of at least one egg for frying, after which the uses to which the other eggs in the dozen were put were determined. The 1,236 respondents who used at least one egg for frying averaged 4.9 eggs per dozen for the purpose. They used slightly more than 40 percent for frying and about 22 percent for preparing other egg dishes, mostly for scrambling. The consumers who used the highest percentage for scrambling—36 percent—used a slightly lower percentage—about 26—for frying.

Based on likes and dislikes for the various uses, the natural eggs had the best over-all acceptance for all uses (table 5). The returns show 99.6 percent likes for the natural eggs, 93.6 percent for the oil-processed eggs, and 92.4 percent for the thermostabilized eggs. In general, the ratios of likes and dislikes were approximately the same for each usage, within each treatment. There was a difference between the percentages of likes for all thermostabilized eggs and the likes for natural eggs under each usage.[3] Likewise, differences existed between the percentage of likes for oil-processed eggs and for natural eggs under each usage. Eggs thermostabilized at 136° F. had somewhat better acceptance than those treated at 130°.

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[3] Statistical tests of the differences between the percentages of likes for all thermostabilized eggs under each usage and the percentages of likes for natural eggs under each of the same usages showed that these differences were highly significant. In other words, had there been no differences between the eggs the chances are only 1 out of 100 that the differences obtained in this study would have occurred as they actually did.

TABLE 4.—*Average uses of a dozen eggs*

Use	Consumers putting one or more eggs to each use [1]		Average number of eggs per dozen for each use [2]								
			Fried	Scrambled	Hard-boiled [3]	Soft-boiled [3]	Poached	Plain cake	Custard	Other uses	Total eggs
	Number	*Percent*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Fried	1, 236	76. 2	*4. 9*	2. 6	0. 8	0. 6	0. 4	0. 7	0. 5	1. 5	12
Scrambled	1, 082	66. 7	3. 1	*4. 3*	. 9	. 6	. 4	. 7	. 6	1. 4	12
Hard-boiled	396	24. 4	3. 0	2. 6	*2. 2*	. 6	. 4	1. 1	. 7	1. 4	12
Soft-boiled	289	17. 8	2. 6	2. 6	. 8	*2. 9*	. 4	1. 1	. 6	1. 0	12
Poached	235	14. 4	2. 5	2. 3	. 9	. 7	*2. 9*	. 9	. 7	1. 1	12
Plain cake	297	18. 2	3. 1	2. 5	. 9	. 6	. 3	*2. 7*	. 8	1. 1	12
Custard	256	15. 7	2. 7	2. 7	. 9	. 6	. 4	1. 3	*2. 2*	1. 2	12
Other uses	945	58. 1	3. 0	2. 6	1. 0	. 6	. 4	1. 1	. 5	2. 8	12
Average use of all eggs, on the dozen basis [4]			4. 07	3. 14	. 88	. 66	. 48	. 78	. 57	1. 42	12

[1] Based on returns from 1,622 consumers. Some of the questionnaire cards were not completed in detail.

[2] Based on answers which were completed for 1,029 dozen eggs.

[3] The terms hard-boiled and soft-boiled were used on the questionnaire because it was thought they might be more generally understood than the more specifically correct terms hard-cooked and soft-cooked.

[4] These figures are based on percentages in column 4 of table 2.

TABLE 5.—*Consumer liking for eggs of different types for different uses* [1]

Egg type	Likes when used as—								
	Fried	Scrambled	Hard-boiled	Soft-boiled	Poached	Plain cake	Custard	Other uses	All uses
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Thermostabilized:									
130° F	91. 4	92. 1	86. 2	86. 7	92. 0	89. 8	93. 6	93. 5	91. 3
136° F	94. 3	92. 9	95. 6	90. 7	92. 3	91. 1	93. 2	92. 5	93. 1
All thermostabilized	93. 2	92. 6	91. 8	88. 9	92. 2	90. 6	93. 4	92. 7	92. 4
Oil-processed	93. 0	92. 1	96. 2	94. 7	94. 1	94. 8	97. 2	95. 4	93. 6
Natural	99. 6	99. 5	100. 0	100. 0	100. 0	100. 0	100. 0	98. 7	99. 6

[1] Answers completed on 1,210 out of 1,622 cards returned.

In all four retail stores natural eggs received the highest rating for all uses (table 6). Thermostabilized and oil-processed eggs were given higher approval for cooking use than for use in egg dishes, except at Store No. 1, where thermostabilized eggs led for table use. A break-down by stores for all uses and all treatments shows that consumers in the high-income area were the most critical.

The space designed for remarks (table 7) was filled in on 689 of the 1,622 cards completed. Of these remarks, 73 percent were complimentary to the eggs, such as "liked the eggs," "eggs were fresh," "yolks had a good color," and "good taste." The other 27 percent were adverse—7 percent indicated "eggs too small" or "eggs too high-priced," and about 20 percent of the cards made reference to physical or functional properties, such as "blood spots," "broken yolks," "white water," and "whites did not whip."

TABLE 6.—*Liking of consumers in different income areas for eggs given different treatments when used in different ways* [1]

Use of eggs given different treatments	Likes of consumers from—			
	Store No. 1 (low-income area)	Store No. 2 (medium-income area)	Store No. 3 (high-income area)	Store No. 4 (high-income area)
	Percent	*Percent*	*Percent*	*Percent*
Table use:				
Thermostabilized eggs	94	98	90	92
Oil-processed eggs	94	88	92	91
Natural eggs	99	100	100	100
Cooking use:				
Thermostabilized eggs	91	100	91	92
Oil-processed eggs	97	95	96	93
Natural eggs	98	100	100	100
All uses from all eggs [2]	95	96	93	93

[1] Answers were completed on 1,210 out of 1,622 cards returned.
[2] Based on weighted averages.

The remarks regarding the natural eggs were 78.6 percent favorable, compared with 73.3 percent for the oil-processed eggs. The eggs thermostabilized at 136° F. received 74.5 percent favorable comment while those treated at 130° received 63.3 percent. Consumers in the high-income areas were the most critical in their remarks on the use of the eggs. Although consumers reported certain defects in the eggs, regardless of treatment, no complaints were received at any store and no eggs were returned.

The most serious complaint against all the experimental eggs, regardless of treatment, was that they were not fresh. This complaint accounted for 6.4 percent of all remarks on eggs thermostabilized at 136° F., 7.4 percent of those on eggs thermostabilized at 130°, 7.5 percent of those on oil-processed eggs, and 3.8 percent of those on the natural eggs. Remarks that the whites did not whip accounted for 5.1

TABLE 7.—*Percentages of remarks on eggs classified by different methods of treatment*

Remark	Egg treatment				Store			
	Thermostabilized		Oil-processed	Natural	No. 1 (low-income area)	No. 2 (middle-income area)	No. 3 (high-income area)	No. 4 (high-income area)
	136° F.	130° F.						
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Favorable	74. 5	63. 3	73. 3	78. 6	84. 4	68. 6	65. 5	65. 1
Unfavorable:								
Yolks	3. 8	5. 5	6. 5	3. 1	1. 8	8. 1	4. 1	8. 1
Whites	6. 8	5. 5	. 5	4. 6	4. 1	0	8. 1	3. 2
Other [1]	9. 4	13. 8	13. 6	6. 1	5. 2	12. 8	16. 2	13. 4
Total	20. 0	24. 8	20. 6	13. 8	11. 1	20. 9	28. 4	24. 7
Other [2]	5. 5	11. 9	6. 1	7. 6	4. 5	10. 5	6. 1	10. 2
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Total remarks	235	109	214	131	269	86	148	186
No remarks	264	198	288	183	173	171	294	295

[1] Included: "Blood and/or meat spots"; "unable to separate white and yolk"; "strong taste"; "off-flavor"; "not fresh."

[2] Included: "Eggs too small"; "eggs too high-priced."

percent of all unfavorable remarks on 136° F. eggs, but were insignificant on eggs receiving the other treatments. The remarks on the whipping of the white were not surprising, as it had been reported by Funk (*1*, *2*), Goresline et al. (*3*), and Slosberg et al. (*5*), and was recognized as one of the defects of the thermostabilization process. Success in making angel food cake depends largely on the fluffiness of the whipped egg albumen, and it was believed that the users of eggs making this cake would comment if they had any difficulty. A check of the questionnaire cards completed for 1,029 dozen eggs of all types showed that 1 percent of the experimental eggs were used to make angel food cake (table 8).

TABLE 8.—*Use of eggs for angel food cake*

Egg type	Percentage of all eggs used	Percentage of likes reported
	Percent	*Percent*
Thermostabilized:		
130° F	0. 6	92. 9
136° F	. 5	100. 0
Oil-processed	. 6	100. 0
Natural	1. 1	87. 5

Contrary to expectations, consumer liking was lowest for natural eggs in making angel food cake, but highest (100 percent) for eggs thermostabilized at 136° F. Not one of those reporting the use of experimental eggs in making angel food cake mentioned any difficulty in whipping the whites.

The reports on 1,029 dozen experimental eggs included 14 instances of difficulty in whipping the whites—12 with eggs thermostabilized at 136° F., 1 for eggs stabilized at 130°, and 1 for natural eggs.

DISCUSSION

The process of thermostabilization retards the rate of quality deterioration in shell eggs. It offers an economic advantage in the storage of shell eggs as it stabilizes the quality better than any other method of treating eggs. However, the successful application of such a process to commercial marketing depends on the acceptance of the product by the consuming public. The purpose of the present study was to determine the acceptability of eggs treated by this method and whether or not the process showed promise of success as a new method of treating market eggs. The study was undertaken from the standpoint of use and functional acceptability. Economic and physical advantages were not explored.

Although a high percentage of questionnaires was returned in the study, the results are subject to certain limitations, as the research was conducted on a pilot scale and in only one city.

In general, only limited changes would be recommended in basic procedures for future studies—an increase in the size and coverage of sampling, a more specific questionnaire, and a reduction in the number of variables. Other parts of the problem should be correlated with the consumer study with special reference to the effects of transportation, handling, and seasonal variation on the quality of eggs under study and the particular conditions under which thermostabilization would offer a marketing advantage.

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